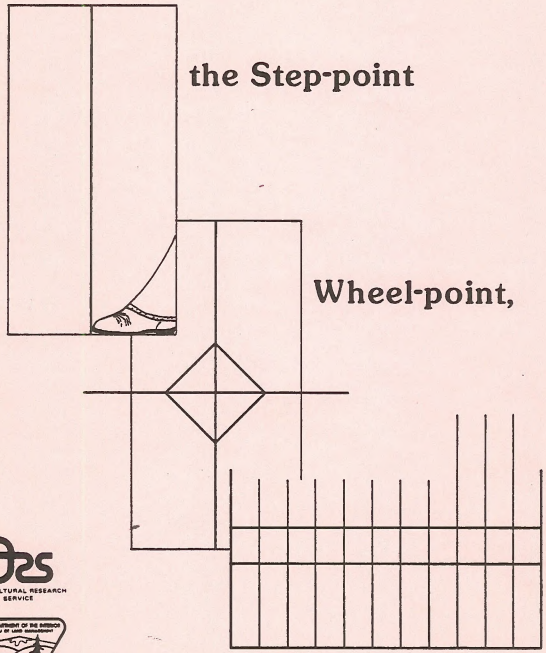
Measuring Cover Using



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Measuring Cover Using the Wheel-point, Step-point, and Point-frame Sampling Methods

By

Clayton L. Hanson, J. Ross Wight, and Clifton W. Johnson

Agricultural Engineer, Range Scientist, and
Research Hydraulic Engineer, respectively;
USDA, Agricultural Research Service,
Northwest Research Center
270 South Orchard
Boise, Idaho 83705

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Measuring Cover Using the Wheel-point, Step-point, and Point-frame Sampling Methods[1]

Clayton L. Hanson, J. Ross Wight, and Clifton W. Johnson[2]

ABSTRACT

This study compares basal and overstory cover as measured by the wheel-point, step-point, and point-frame cover sampling methods on a sagebrush-grass rangeland in southwestern Idaho. The results show that all three point methods provided similar estimates of basal plant cover, but there were some significant differences in first hit measurements with the point-frame measuring less plant cover and more litter, rock, and bare ground than the other two methods. There was also strong evidence of operator bias.

Key Words: Rangeland, Vegetation, Grassland, Basal Cover, Canopy Cover

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[1]Contribution from the Northwest Watershed Research Center, Agricultural Research Service, USDA; in cooperation with the Bureau of Land Management, USDI, and the Agricultural Experiment Station, University of Idaho, Moscow, Idaho 83843.

[2]Agricultural Engineer, Range Scientist, and Research Hydraulic Engineer, respectively; USDA, ARS, 270 South Orchard, Boise, Idaho 83705.

Introduction

Plant cover is a vegetation parameter which is widely used to describe ecological and hydrological conditions of rangelands (National Academy of Sciences 1962). It is a complex parameter because there are many types of cover and many ways to determine it. A major problem in determining cover is the lack of consistency among methods and individuals using the same method. Even though point methods of measuring cover are less subjective than area estimate methods, they still contain high levels of individual bias. Extensive citations on the use of point quadrat methods are given by Morris (1967), and Greig-Smith (1983). The purpose of this study was to compare three point-quadrat methods for measuring cover in three plant communities.

The three methods compared were: 1) wheel-point (Figure 1) (Tidmarsh and Havenga 1915, and von Broembsen 1965); 2) step-point (Figure 2) (Evans and Love 1957, and U.S. Department of Interior 1979); and 3) vertical ten-pin point-frame (Figure 3) (Goodall 1952, National Academy of Sciences 1962, and Hutchings and Pase 1963).

Study Area and Methods

This study was conducted at four sites on the Reynolds Creek Experimental Watershed in southwest Idaho. The Flats, Nancy Gulch, and Whiskey Hill study sites were sampled in 1981 using the wheel-point, step-point, and point-frame methods. In 1982, Nancy Gulch and Lower Sheep Creek were sampled using only the wheel-point and point-frame methods. All sampling was done near peak

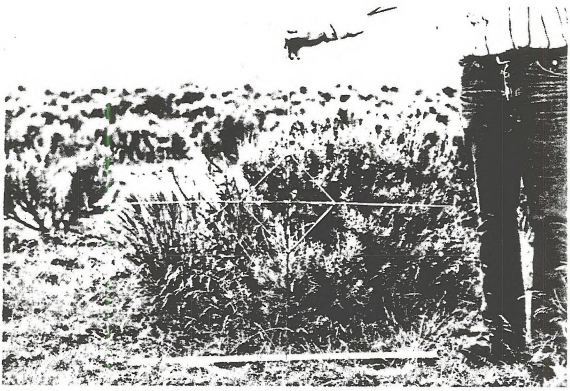

Figure 1. The wheel-point used in this study.

Figure 2. Step-point method using the pin at the toe of the boot.

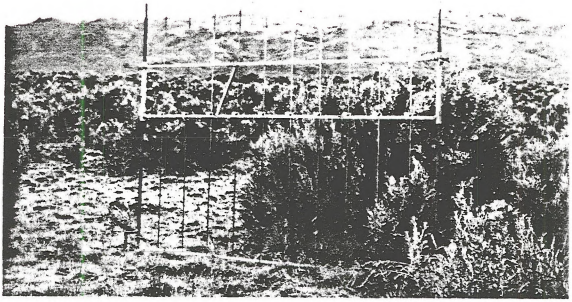

Figure 3. The ten-pin vertical point frame used in this study.

standing crop. One person did all of the sampling in 1981 and another person did the sampling in 1982. The Flats site is a shadscale (Atriplex confertifolia) -grass community, the Nancy Gulch and Whiskey Hill sites are Wyoming big sagebrush (Artemisia tridentata wyomingensis) -grass communities, and the Lower Sheep Creek site is a low sagebrush (Artemisia arbuscula) community.

In 1981, a base line was established at each sampling site and all point sampling was made along 200-foot line transects which ran perpendicular to the base line at 10-foot intervals. The wheel-point was run continuously along the line transects; the point-frame was set at 20-foot intervals (10 per transect); and the step-point data were obtained at step distances which enabled the observation of 100 points per line transect. There were 1000 sample points per method at each sampling site. In 1982, the point-frame points were increased to 2500 points by increasing the transect length to 250 feet and setting the frame at 10-foot rather than 20-foot intervals.

The wheel-point method provided point samples at 2-foot intervals as the wheel spokes were rotated (Figure 1). A pin guided by a notch in the boot was used in the step-point method (Figure 2). The wheel-point and step-point pins were 0.2 inches in diameter without sharpened points. Plant hits with the wheel-point and step-point methods were recorded when any plant part was touching the pin after the pin end was resting on the ground, and the pin was in a vertical position. For these two sampling methods, only the uppermost vegetative hit and the ground-level hit were recorded.

With the pins resting on the ground as in the step-point and wheel-point methods, a pin could be in contact with more than one recorded category. In these situations, only one ground-level hit was recorded using the following order of priority. Live vegetation was recorded first followed by litter (dead vegetation), rock, and bare ground. Only rock 0.08 inch or more in diameter was counted.

Ten-pin, point-frames were used in both 1981 and 1982. The point-frame used in 1981 had pins 2.5 inches apart. The pins were 6.0 inches apart in the frame used in 1982. The diameter of the point-frame pins was 0.2 inches and they were sharpened to a fine point on the tip (similar to a sharpened pencil). For the point-frame, only the first above-ground and ground-level hits on the point of the pin were recorded as the pin was moved through the frame to ground level.

Differences between sampling methods were evaluated using Chi-square analysis for proportions (Snedecor and Cochran 1967, Greig-Smith 1983). All results reported as statistically significant refer to the 0.05 probability level.

Results and Discussion

Basal Cover

All three methods provided similar estimates of basal cover with the point-frame tending to measure slightly less forb and more litter than the other two methods (Table 1). In 1981, the point-frame measured more rock and less bare ground than did the other two methods. These results were reversed

Table 1. Basal cover in percent[1] measured by the step-point, wheel-point, and point-frame methods.

Site and year	Method	Grasses	Forbs	Shrubs	Litter	Rock	Bare ground
Flats	step-point	<.05	5ab[2]	0	41[a]	4[b]	50[a]
(1981)	wheel-point	<.05	7[a]	0	42[a]	2[b]	49[a]
	point-frame	<.05	3[b]	<.05	43[a]	8[a]	46[b]
Nancy Gulch	step-point	<.05	18[b]	0	24[b]	5[b]	53[a]
(1981)	wheel-point	<.05	23[a]	0	23[b]	2[b]	52[a]
	point-frame	<.05	17[b]	<.05	29[a]	9[a]	45[b]
Whiskey Hill	step-point	0	1[a]	0	73[b]	2[a]	24[a]
(1981)	wheel-point	0	1[a]	0	73[b]	2[a]	24[a]
	point-frame	0	1[a]	0	79[a]	2[a]	18[b]
Nancy Gulch	wheel-point	1	50[a]	<.05	<.05	16[a]	33[b]
(1982)	point-frame	1	48[a]	<.05	2	13[b]	36[a]
Lower Sheep Creek	wheel-point	<.05	52[a]	1	<.05	19[a]	28[b]
(1982)	point-frame	<.05	47[b]	1	1	17[a]	34[a]
Average	wheel-point	<.05	27	<.05	28	8	37
	point-frame	<.05	23	<.05	31	10	36

[1]Percentage based on 1000 point quadrats per vegetation survey method except at the Nancy Gulch and Lower Sheep Creek sites in 1982, where the percentage for the point-frame method was based on 2500 point quadrats.

[2]The average basal cover at each site for the step-point, wheel-point, and point-frame methods with the same superscript letter are not significantly different at the 0.05 probability level.

in 1982 with the point-frame measuring less rock and more bare ground than did the wheel-point method. This reversal of results could be due to both climate and technician bias.

The greatest differences in measured basal cover occurred between years. In 1982, the operator measured more rock and forbs and less litter and bare ground than was measured in 1981. With similar growing conditions, grazing management, and sampling seasons for both years, it is very unlikely that the differences in these factors caused the forb cover to increase 2-to-3-fold and the litter cover to decrease from greater than 20 percent to less than 2 percent. A difference of this magnitude is strongly indicative of operator bias and methodology. Most of the increases in forbs and decreases in litter shown in 1982 were probably due to the recording of hits on the phloxes and mosses that occurred underneath the ground litter as basal cover. In 1981, the operator did not identify the phloxes and mosses underneath the litter as ground cover. This also explains why the 1982 operator measured more first hit litter (Table 2) than basal cover litter (Table 1).

First Hit Cover

First hit cover can be thought of as the first contact a raindrop might have with vegetation, litter, rock, or bare ground. The step-point and wheel-point methods gave essentially the same results for all first hit cover measurements (Table 2). There were some large differences between the point-frame and the other two methods (Table 2). In general, the point-frame measured less first hit plant cover and more litter, rock and bare ground than did the wheel-point and step-point methods.

Table 2. First hit cover (percent) by the step-point, wheel-point, and point-frame methods.

Site	Method	Grasses: Cheatgrass brome	Grasses: Sandberg bluegrass	Grasses: Bottlebrush squirreltail	Grasses: Total	Forbs	Shrubs: Big sagebrush	Shrubs: Low sagebrush	Shrubs: Shadscale	Shrubs: Total	Litter	Rock	Bare ground
Flats[1]	step-point	57	T<.05	2	60[a3]	7[a]	6	--	3	10[a]	2[b]	2[b]	19[b]
(1981)	wheel-point	56	T<.05	3	60[a]	7[a]	6	--	4	11[a]	3[b]	1[b]	18[b]
	point-frame	33	T<.05	3	37[b]	5[a]	4	--	3	7[a]	16[a]	5[a]	30[a]
Nancy	step-point	<.05	33	1	35[a]	8[b]	13	--	--	13[a]	5[b]	4[b]	35[a]
Gulch	wheel-point	<.05	33	1	35[a]	10[b]	15	--	--	16[a]	6[b]	2[b]	31[a]
(1981)	point-frame	0	12	1	13[b]	13[a]	16	--	--	16[a]	13[a]	8[a]	37[a]
Whiskey	step-point	44	6	1	53[a]	7[a]	21	--	--	29[b]	4[b]	1[a]	6[b]
Hill	wheel-point	35	6	1	46[b]	8[a]	25	--	--	36[a]	4[b]	1[a]	5[b]
(1981)	point-frame	26	2	1	31[c]	9[a]	18	--	--	25[c]	25[a]	1[a]	9[a]
Nancy	wheel-point	1	19	7	34[a]	9[b]	9	--	--	11[a]	26[a]	9[a]	11[b]
Gulch	point-frame	<.05	8	3	13[b]	21[a]	7	--	--	7[b]	27[a]	10[a]	22[a]
(1982)													
Lower	wheel-point	--[2]	24	1	28[a]	11[b]	--	26	--	27[a]	29[a]	6[b]	3[b]
Sheep	point-frame	--	7	<.05	10[b]	17[a]	--	22	--	23[b]	26[a]	11[a]	13[a]
Creek (1982)													
Avg.	wheel-point				40	9				20	13	4	14
	point-frame				21	13				16	21	7	22

[1] Percentage based on 1000 point quadrats per vegetation survey method except at the Nancy Gulch and Lower Sheep Creek sites in 1982 where the percentage for the point-frame method was based on 2500 point quadrats.

[2] Not present on the site.

[3] Only totals were tested for significant differences at the 0.05 probability level.

Grass cover measured by the point-frame method was only about half that measured by the other two methods. Litter, rock, and bare ground cover averaged about 40 percent higher by the point-frame than by the wheel-point method. For forbs and shrubs, the differences occurred primarily in 1982 where the point-frame forb cover was nearly double that measured by the wheel-point, and the shrub cover was less by the point-frame than by the wheel-point method. The differences between the point-frame, and the wheel-point and step-point methods are due primarily to the differences in pin size. The large pins of the wheel-point and step-point methods simply intercepted more canopy than did the small point of the point-frame pins. This pin size/cover relationship is similar to that found by others (Goodall 1952). With more canopy hits there would be less ground level hits and therefore less litter, rock, and bare ground.

Comparison of the Nancy Gulch site data over the two years (Table 2) indicated a major difference in the amount of litter and bare ground recorded by the two operators. The 1982 operator measured more first hit litter and less bare ground than did the 1981 operator.

Again, the magnitude of difference between methods for the different operators was more than would be expected due to climate and management variations and indicated a method-operator interaction. For example, the 1981 operator recorded higher first hit litter and rock cover and no difference in bare ground with the point-frame method, while the 1982 operator recorded no difference in litter and rock but higher bare ground with the point-frame method.

In using the point method, the area of the point and what is considered a "hit" is critical. If just the contact of the point of the pin with vegetation is considered a "hit", then, as the area of the point increases, the cover estimates are biased upward. Likewise, if any contact against the pin is considered a "contact", the larger the diameter of the pins, the larger the cover estimate. Comparisons of point "hits" with pins of different sizes are not valid.

Perhaps the biggest error in using points to measure cover is the inability of different operators to measure the same things and to measure them the same way. The following questions should be examined before cover measurements begin:

1. What are the results going to be used for: Surface hydrology, subsurface hydrology, erosion, trend, etc.?

2. At what distance above the ground is a "hit" determined to be a ground (basal) hit or a canopy "hit"? Much would depend on if the data are used for erosion estimates for protection from raindrop impact; then any distance that effectively reduces rainfall energy would be suitable for a canopy "hit".

3. How are lichens, mosses, and fine particles of organic debris on the soil surface classified?

4. Has the site been documented with photographs? Has a writeup been included that will carefully document the methodology so that it can be repeated by different operators?

Conclusions

In general, cover information obtained by the step-point and wheel-point methods was the same for both basal and first hit cover. However, these two methods measured significantly more plant cover and less litter, rock, and bare ground than did the point-frame method. The data from this study indicate first hit data from the wheel-point and step-point methods are not comparable to data obtained by the point-frame method. It also indicates that operator bias, even using the same sampling method, can affect the results of the survey.

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